

## Review of the Deep Sea Squaloid Shark Genus *Scymnodon* of Japan, with a Description of a New Species

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**Abstract** *Scymnodon* in Japan is represented by two species, *S. squamulosus* and *S. ichiharai* sp. nov. The new species differs from other species of the genus by the shape of 1st dorsal fin, dermal denticles and lower teeth, the head length, and the interspace between the pelvic and caudal fins. *S. squamulosus* is redescribed from 12 specimens. *S. obscurus* is regarded as a junior synonym of *S. squamulosus*. A key to the species of *Scymnodon* is given. *Scymnodon* is closely related to *Centroscyrnus*.

The deep sea shark genus *Scymnodon*, belonging to the family Squalidae, can be distinguished from related genera by: its upper teeth being much longer midway along each side of jaw than either toward the center of the mouth or toward its outer corner; broadly rounded inner corners of the pectoral fins; and no concave crown-like dermal denticles.

Bocage and Capello (1864) established *Scymnodon* as a new genus, and described *S. ringens* from Portugal. From the seas around Japan, Günther (1877) described a species, *S. squamulosus*, which he originally placed in the genus *Centrophorus*. Jordan and Fowler (1903) proposed a new genus *Zameus* for *C. squamulosus* but Regan (1906) referred *squamulosus* to *Scymnodon*. Garman (1913) included in *Scymnodon* the species *S. ringens*, *S. squamulosus*, *S. macracanthus* (Regan, 1906), from Magellan, *S. plunketi* (Waite, 1910), from New Zealand, and treated *Centroscyrnus obscurus* Vaillant, 1888, off the coast of north-western Africa, as a synonym of *S. ringens*. Archey (1921) described a new species, *S. sherwoodi* which Garrick (1956) later placed in a new genus *Scymnodalatias* within the Dalatiidae. Fowler (1933) proposed for *S. plunketi* a new subgenus *Proscymnodon* which Whitley (1934) regarded as a genus. Fowler (1940), also, referred *S. squamulosus* and *S. sherwoodi* to a subgenus *Zameus*, *S. ringens* to a subgenus *Scymnodon*, and *S. plunketi* to a subgenus *Proscymnodon*. Bigelow and Schroeder (1954) reported that *S. melas* Bigelow, Schroeder et Springer, 1953 was a juvenile

stage in the growth of *Centroscyrnus coelolepis*. Bigelow and Schroeder (1957) referred *S. ringens*, *S. squamulosus* and *S. obscurus* to *Scymnodon* but placed *S. plunketi* and *S. macracanthus* in *Centroscyrnus*. Garrick (1959b) identified *C. plunketi* as a species of *Scymnodon*. *S. plunketi* and *C. macracanthus* have been variously placed in *Centrophorus*, *Centroscyrnus* and *Scymnodon* by several authors. Recently, the genus *Scymnodon* was stated as including four species: *S. ringens*, *S. squamulosus*, *S. obscurus* and *S. plunketi* (Cadenat and Blache, 1981).

The new species *S. ichiharai* is described here on the basis of 14 specimens caught in Suruga Bay and adjacent waters. It is clearly discriminated from the closely related *S. plunketi* and *S. ringens*.

The denticles of the trunk of *S. squamulosus* as pictured by Günther (1887) show no trace of transverse ridges. Bigelow and Schroeder (1957), and Cadenat and Blache (1981) used the absence (*squamulosus*) or the presence (*obscurus*) of transverse ridges on the denticles as the main difference between these species. But our reexamination of the dermal denticles of the holotype of *S. squamulosus* from the British Museum revealed that transverse ridges are present in that species just as they are in *S. obscurus*.

### Materials and methods

The Japanese specimens used for this study were caught with bottom longlines and bottom drop lines, which were set at depths between 400 m and 1,500 m. These localities are shown

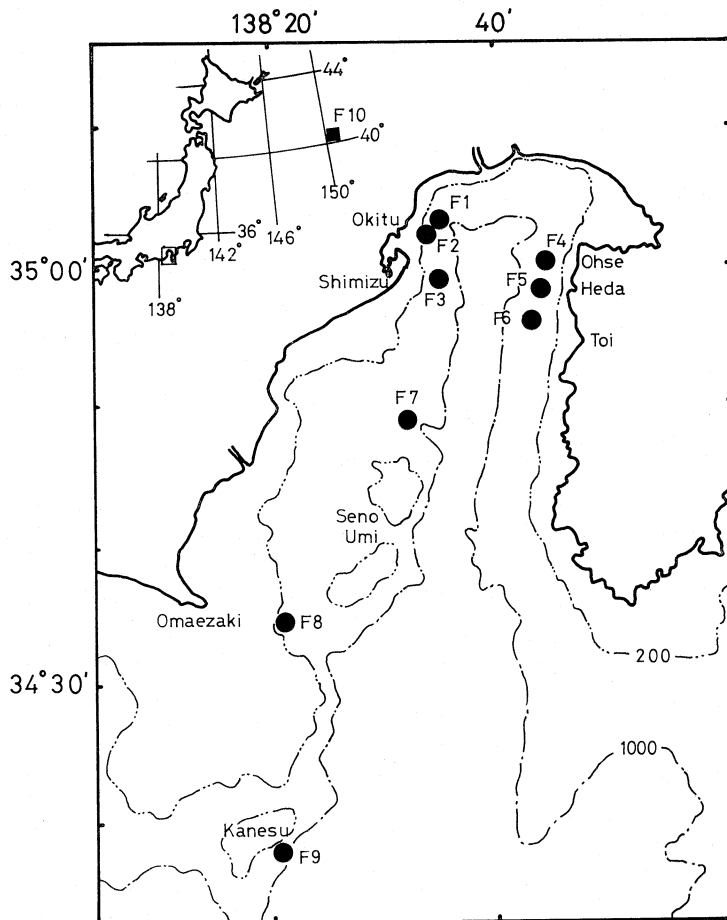


Fig. 1. Fishing grounds of *Scymnodon ichiharai* sp. nov. and *S. squamulosus*. F1~F8, fishing area of *S. ichiharai*; F8~F10, fishing area of *S. squamulosus*; ●, caught with bottom longline and bottom drop line; ■, caught with floating longline.

in Fig. 1. The specimens of *S. plunketi*, NSMT-P42001 (bottom trawl, off New Zealand, 48°51'S, 167°22'E, Apr. 13, 1983, 585~632 m in depth), FSFL-EH 858 (Kaiyo Maru, off New Zealand, 42°39.5'S, 176°01.6'E, Dec. 12, 1977, 1,025~1,027 m in depth) and FSFL-L 461 (Kaiyo Maru, off New Zealand, 48°15.0'S, 179°52.0'E, Dec. 15, 1974, 520 m in depth), were used for comparison with our specimens. Denticles of the type specimens of *S. squamulosus*, *S. ringens*, *S. obscurus* and *S. plunketi* from the British Museum (Natural History), Muséum National d'Histoire Naturelle and Canterbury Museum (New Zealand) were used for comparison with those of our specimens.

Specimens are deposited in the following

institutions: Department of Zoology, British Museum (Natural History) (BMNH); Far Seas Fisheries Research Laboratory, Shimizu (FSFL); Department of Fisheries, University Museum, University of Tokyo (FUMT); National Science Museum, Tokyo (NSMT); Elasmobranchii Collection of the Department of Fisheries, Faculty of Marine Science and Technology, Tokai University (TMFE); and Marine Science Museum, Tokai University (MSM).

Measurements were carried out in the same way as in Yano and Tanaka (1983), with the addition of the following items: snout tip to anterior margin of spiracle; interspace between 1st dorsal and 2nd dorsal fin spines; interspace between 2nd dorsal and caudal fins; interspace

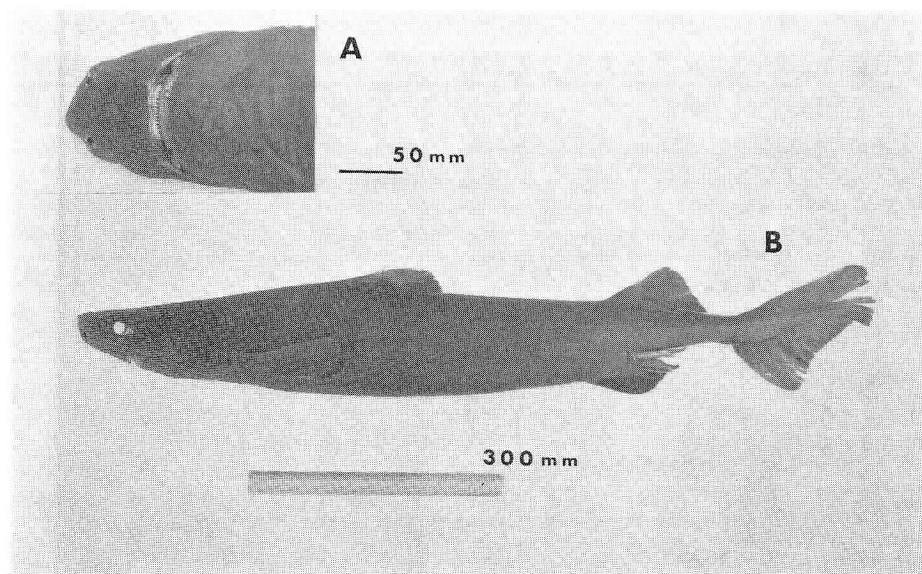


Fig. 2. Holotype of *Scymnodon ichiharai* sp. nov., male, 1,011 mm TL, NSMT-P 21723. A, ventral view of head region; B, lateral view.

between pelvic and caudal fins; distance between origins of pectoral and pelvic fins; length of the posterior margin of 1st dorsal and 2nd dorsal fins; depth of pelvic fin; and depth of subterminal notch.

Dermal denticles were studied under a binocular microscope and photographed with a scanning electron microscope.

The vertebral counts were made according to the method of Springer and Garrick (1964). Soft X-ray was used for counting the number of vertebrae of small sharks.

All turns in the spiral valves were counted in the left lateral view of the ileum.

*Scymnodon ichiharai* sp. nov.

(New Japanese name:

Ichihara-biroudozame)

(Fig. 2)

**Holotype.** NSMT-P 21723, male, 1,011 mm in total length (TL), 829 mm in body length from snout tip to upper caudal origin (BL), off Okitsu in Suruga Bay (35°02.9'N, 138°34.6'E), 580 m in depth, bottom drop line, Mar. 16, 1982.

**Paratypes.** Fishing areas are shown in Fig. 1. BMNH 1983.11.8: 1, male, 955 mm TL, 799 mm BL, off Okitsu (fishing area F2), 690~790 m in depth, bottom longline, June 5, 1980. FUMT-P 3849, male, 927 mm TL, 775 mm BL, off Toi (F6), 665~720 m in depth, bottom longline, July 17, 1980.

MSM-80-273, male, 892 mm TL, 733 mm BL, off Heda (F5), bottom longline, July 30, 1980. TMFE 169, male, 993 mm TL, 820 mm BL, off Yui (F1), 800 m in depth, bottom longline, Aug. 25, 1980. TMFE 1138, male, 924 mm TL, 745 mm BL, off Okitsu (35°02.8'N, 138°34.5'E, F2), 500 m in depth, bottom drop line, June 30, 1982. TMFE 1275, male, 492 mm TL, 387 mm BL, off Omaezaki (34°29.8'N, 138°24.9'E, F8), 450~830 m in depth, bottom longline, Nov. 9, 1982. TMFE 1875, male, 951 mm TL, 780 mm BL, off Yui (35°02.0'N, 138°37.0'E, F1), 700 m in depth, bottom drop line, May 14, 1983. NSMT-P 21724, female, 1,340 mm TL, 1,125 mm BL, off Heda (F5), 675~750 m in depth, bottom longline, Nov. 20, 1980. FUMT-P 3850, female, 1,455 mm TL, 1,221 mm BL, Seno Umi (F7) 630~645 m in depth, bottom longline, July 29, 1981. TMFE 76, female, 1,367 mm TL, 1,127 mm BL, off Ohse (F4), 620~720 m in depth, bottom longline, July 16, 1980. MSM-80-274, female, 1,260 mm TL, 1,021 mm BL, off Ohse (F4), 620~720 m in depth, bottom longline, July 16, 1980. TMFE 78, female, 1,266 mm TL, 1,066 mm BL, off Ohse (F4), 620~720 m in depth, bottom longline, July 16, 1980. TMFE 288, female, 1,230 mm TL, 1,040 mm BL, off Miho (F3), bottom longline, Oct. 31, 1980.

**Diagnosis.** Length from snout tip to 1st dorsal fin spine 42.4~46.9% of body length. Interspace between pelvic and caudal fins 10.2~14.0% of body length. Pectoral fin not reaching a vertical from the 1st dorsal fin spine. Lower

Catalogue number	Holotype			Paratypes														
	NSMT-P	TMFE	MSM-80-	TMFE	male	male	male	male	male	male	female	female	female	female	female	female	FUMT-P	FUMT-P
21723	1275	1275	273	1138	3849	1875	1983, 11.8;1	169	288	80-274	1,230	1,260	1,266	21724	76	3850		
Sex	male	male	male	male	male	male	male	male	male	female	female	female	female	female	female	female		
Total length (mm)	1,011	492	892	924	927	951	955	993	1,230	1,260	1,266	1,340	21724	76	3850			
Snout tip to:																		
outer nostrils	1.9	2.1	1.9	1.6	1.9	2.2	1.4	1.8	1.6	1.6	1.7	2.8	1.9	2.7				
eye	4.6	5.3	5.6	3.6	5.0	5.3	4.6	4.5	3.7	3.6	4.1	4.6	5.3	5.2				
spiracle	11.7	12.2	12.7	10.7	11.0	10.9	11.5	10.6	11.4	9.9	9.8	12.2	11.6	10.3				
mouth	7.2	6.7	7.7	6.6	7.2	7.5	6.3	6.2	6.5	5.4	7.1	5.6	6.9	5.6				
1st gill opening	17.0	17.1	18.8	17.1	16.1	17.9	17.5	15.6	17.9	13.9	15.8	15.7	15.9	14.5				
5th gill opening	22.0	21.5	22.5	22.0	20.3	22.1	21.2	19.3	24.0	18.7	20.7	19.4	20.3	18.6				
pectoral origin	22.3	22.0	22.7	22.1	21.1	22.2	21.4	19.1	23.6	19.0	21.5	19.4	20.5	19.3				
pelvic origin	60.8	60.8	61.7	60.9	61.9	62.7	63.1	62.5	64.6	60.4	65.2	65.7	61.8	63.8				
cloaca	66.8	67.5	67.7	67.1	67.4	68.5	67.7	68.7	68.7	67.2	69.2	69.8	67.4	70.2				
1st dorsal spine origin	34.8	36.6	36.2	36.3	36.5	36.2	37.0	33.2	38.9	36.8	38.2	38.4	35.5	36.1				
2nd dorsal spine origin	68.2	68.5	69.8	68.7	68.5	70.9	70.8	67.6	70.7	69.4	72.1	72.0	69.2	72.2				
upper caudal origin	82.0	78.7	82.2	80.6	83.6	82.0	83.7	82.6	84.6	81.0	84.2	84.0	82.4	83.9				
lower caudal origin	78.5	77.0	79.0	77.9	79.8	79.0	82.6	80.9	83.2	78.8	81.5	82.4	79.7	80.8				
Interspace between:																		
1st dorsal and 2nd dorsal spine origins	28.6	27.6	30.5	27.3	28.5	29.4	30.3	28.2	28.5	27.7	29.6	29.1	29.4	32.0				
2nd dorsal and caudal pelvic and caudal	6.9	7.7	8.1	6.0	8.1	7.2	7.3	7.0	6.1	8.1	6.6	7.1	7.3	6.2				
Distance between origins of pectoral and pelvic	11.4	11.0	10.3	9.8	11.0	9.5	11.1	11.1	11.4	10.9	9.9	10.4	10.2	8.6				
Nostrils: distance between inner corners	41.0	38.0	37.6	38.6	42.2	41.5	42.1	—	38.6	43.0	44.1	39.0	41.3	44.8				
Mouth width	4.4	B	3.9	4.1	4.5	4.2	4.5	4.5	5.3	4.7	4.2	4.5	4.2	4.5				
Preoral clefts: distance between inner corners	9.1	10.6	9.3	10.2	8.8	8.7	9.4	8.7	10.2	9.9	8.5	9.7	9.5	8.6				
between inner corners	6.6	6.3	6.6	7.3	6.6	6.5	7.0	—	6.7	6.7	6.0	5.9	6.2	6.1				



Gill opening lengths:															
1st	2.3	1.6	2.1	1.6	2.2	2.1	2.1	1.5	2.4	2.5	2.1	2.2	2.6	2.7	
5th	2.5	1.6	2.1	1.8	1.9	2.1	2.1	2.2	2.8	2.4	2.1	2.1	2.4	2.4	
Horizontal diameter of eye	4.3	6.1	5.6	5.4	4.9	5.3	5.2	4.8	4.9	4.1	4.3	4.1	4.2	3.8	
Interorbital width	9.1	10.2	8.4	8.7	9.0	9.4	9.0	—	9.6	9.1	8.5	9.1	9.3	9.1	
First dorsal fin:															
length of base from spine	4.0	4.1	3.4	4.3	4.5	3.7	4.0	—	3.7	4.0	4.1	3.6	4.4	3.6	
length of posterior margin	4.0	4.1	3.9	3.8	4.3	3.2	4.7	5.0	4.1	4.4	3.9	4.1	4.0	4.1	
height	3.5	2.6	3.4	3.5	4.4	3.2	3.7	3.5	4.1	3.3	3.4	3.1	3.3	3.4	
spine length	2.0	1.2	2.0	1.6	1.4	1.8	0.9	1.1	0.7	1.4	B	B	0.7	0.7	
Second dorsal fin:															
length of base from spine	6.1	5.7	5.8	6.0	5.7	5.5	5.8	—	6.0	6.3	6.1	5.9	5.9	5.5	
length of posterior margin	8.4	6.7	7.2	8.7	7.6	6.7	8.4	8.1	8.1	8.7	7.5	7.5	6.6	6.9	
height	6.4	4.5	5.6	6.0	5.4	5.7	5.8	5.5	6.1	6.4	5.9	5.6	5.5	5.7	
spine length	1.7	0.6	1.4	1.2	0.6	1.5	0.7	0.3	H	B	B	H	0.7	H	
Pectoral fin:															
length of anterior margin	10.9	12.2	13.5	13.3	10.8	13.0	12.0	11.9	15.0	14.3	12.2	12.7	12.7	13.4	
length of distal margin	6.6	5.1	7.3	4.9	7.4	7.9	5.2	5.5	7.3	7.9	6.7	4.5	5.6	4.9	
Pelvic fin:															
length of anterior margin	7.9	7.1	6.7	7.6	7.0	7.4	7.9	8.1	8.1	7.9	8.3	7.5	8.4	6.9	
depth	4.9	4.5	4.8	5.8	5.9	—	5.5	—	6.9	5.6	6.3	5.5	5.9	6.3	
Caudal fin:															
length of upper lobe	18.3	22.4	18.2	19.7	19.4	19.2	17.8	17.6	19.1	19.8	17.4	17.2	17.9	17.2	
length of lower lobe	12.2	12.8	11.2	13.4	12.4	11.6	11.5	11.9	13.8	11.5	11.5	11.2	12.4	11.8	
depth of notch	2.3	4.1	2.2	2.7	2.2	2.6	3.1	2.3	2.4	2.4	1.3	1.9	1.8	1.7	
Trunk at pectoral origin:															
width	14.8	14.6	14.0	15.2	14.6	14.2	15.4	16.6	17.5	16.3	15.6	15.7	16.5	15.1	
height	10.9	13.2	10.7	13.2	10.2	11.8	11.7	11.1	13.4	9.7	13.4	11.2	11.7	12.3	

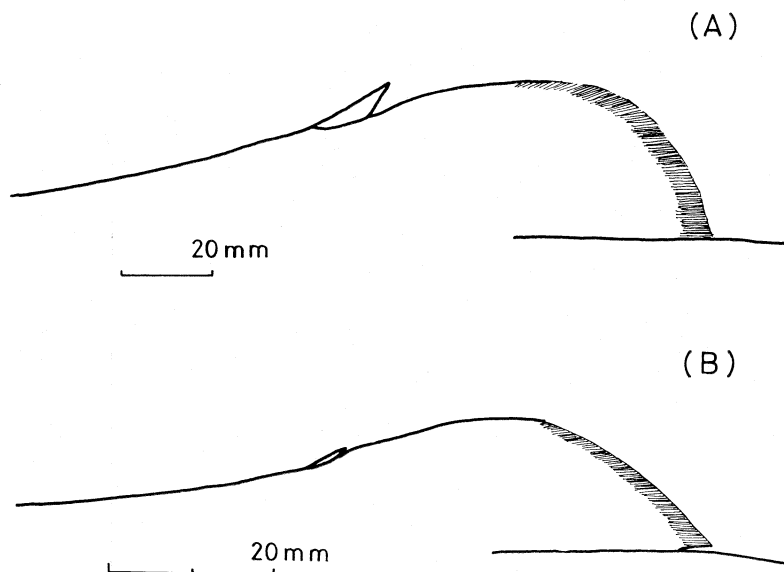


Fig. 3. Shape of 1st dorsal fin of *Scymnodon ichiharai* sp. nov. and *S. squamulosus*. A, holotype, male, 1,011 mm TL, NSMT-P 21723; B, *S. squamulosus*, male, 547 mm TL, NSMT-P 21725.

teeth triangular, oblique, with rectangular bases, their cutting edges inclined toward the outer corners of the jaw. Median lower tooth not symmetrical. Dermal denticles of adults leaf-like, their posterior margins not tridentate but with serrations or smooth. External surface of the denticles lacking transverse ridges, but with three distinct longitudinal ridges.

*S. ichiharai* is distinguishable from other species by the following characters: from *S. ringens* in having the first dorsal fin spine located anterior to the mid point of body length (length from snout tip to 1st dorsal fin spine 53.6% of body length in *S. ringens*), the oblique shape of the lower teeth and the median tooth not symmetrical, the dermal denticles without tridentate posterior margins in adults, and the lower margin of caudal fin with well-marked subterminal notch; from *S. squamulosus* in having the oblique shape of the lower teeth and the median tooth not symmetrical, and the dermal denticles without transverse ridges; from *S. plunketi* in having the dermal denticles without tridentate posterior margins in adults, the shorter interspace between pelvic and caudal fins, the longer head length, the dorsal fin spine relatively large, and the posterior margin of 1st dorsal fin steep.

**Description.** Proportional dimensions in percentage of TL are shown in Table 1. In the

following, the value for the holotype is followed by ranges of paratypes in parentheses.

Trunk subcylindrical; head depressed, flat above, and broad; abdominal ridges weak. Height of trunk at origin of pectoral 13.3% (11.9~16.8%) of body length. Caudal peduncle without lateral keels or precaudal pits. Snout short, its length anterior to eye 0.92 (0.73~1.52) in horizontal diameter of eye and 1.96 (1.50~2.67) in interorbital width. Length from snout tip to mouth 1.26 (1.07~1.67) in posterior end of eye to 1st gill opening. Eye large, vertical diameter of eye 2.15 (1.92~3.00) in horizontal diameter. Spiracle semicircular, its length 2.39 (2.25~4.17) in horizontal diameter of eye. Gill opening small, almost vertical. Length of 1st gill opening 1.87 (1.38~3.75), 3rd 1.87 (1.38~3.75), 5th 1.72 (1.71~3.75) in horizontal diameter of eye. Nostrils oblique, each nasal aperture subdivided into a circular, anterolateral aperture and an elongate, subovoidal, posteromedial aperture by posterior nasal flap, which extends anteriorly as a fleshy triangular process from posterior nasal margin. Mouth broad and little arched, its width greater than preoral length. Preoral length 1.26 (1.16~1.83) in mouth width. Upper lip fimbriated, lower lip smooth. Preoral clefts deep. Distance between inner corners of nostrils 1.52 (1.29~

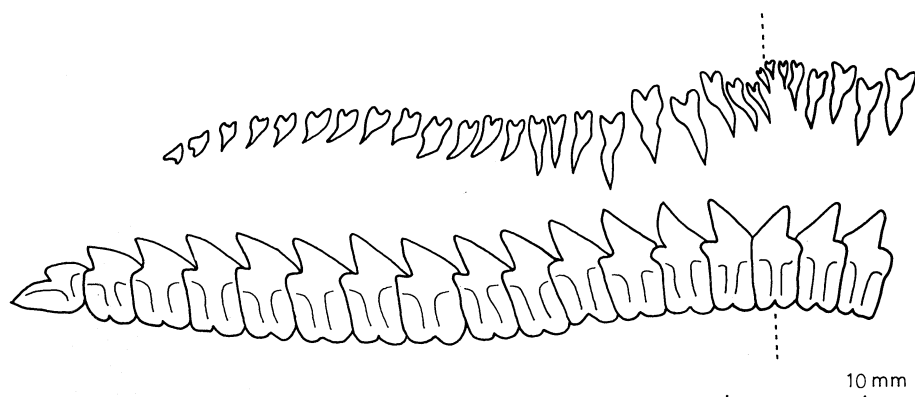


Fig. 4. Teeth of *Scymnodon ichiharai* sp. nov., paratype, male, 993 mm TL., TMFE 169.

1.76) in distance between inner ends of preoral clefts. Pectoral fin, when laid back, in advance of 1st dorsal spine. Posterior margin of 1st dorsal fin shorter than anterior margin, posterior margin steeply sloped (Fig. 3 A). First dorsal fin dissimilar in shape to 2nd dorsal fin. Length of 1st dorsal fin base 1.55 (1.26~1.73) in length of 2nd dorsal fin base. Height of 1st dorsal fin 1.14 (0.92~1.54) in length of 1st dorsal fin base. First dorsal spine relatively large, but its relative size decreases with growth of body length, length of spine 58.1% (16.0~60.0%) of 1st dorsal fin height. Length of 1st dorsal fin base 5.55 (4.48~6.70) in head length. Length of anterior margin of 2nd dorsal fin as long as its posterior margin, 2nd dorsal fin triangular-shaped. Height of 2nd dorsal fin as long as length of 2nd dorsal fin base. Spine of 2nd dorsal fin slightly shorter than that of 1st dorsal. Length of 2nd dorsal spine 20.6% (12.0~25.9%) of 2nd dorsal fin height, but 2nd dorsal spine of three large female specimens (1,230 mm, 1,340 mm and 1,455 mm TL) is hidden by skin. Pectoral fin rounded, posterior margin curved, its origin just posterior to 5th gill opening. Pelvic axilla just below 2nd dorsal spine. Length of anterior margin of pelvic as long as that of posterior margin. Clasper subcylindrical, with spur present.

Teeth  $\frac{21-1-20}{14-1-14}$  ( $\frac{23-1-24}{14-1-15}$  in 993 mm TL, male and  $\frac{22-1-22}{15-0-13}$  in 937 mm TL, male), dissimilar in both jaws. Upper teeth single cusped, smooth-edged, lanceolate. Counting from the symphysis, the teeth in the 1st and 2nd series

are smaller than those in the 4th to 7th series, which include the largest teeth in the upper jaw (Fig. 4). Lower teeth triangular, oblique, with rectangular bases, their cutting edges inclined toward the outer corner of the jaw. Median lower tooth not symmetrical (Fig. 4). Two or three rows of teeth regularly functional in upper jaw, and one in lower jaw.

Dermal denticles of adults small, leaf-like. Posterior margins of the dermal denticles on the trunk below 1st dorsal fin have three to seven serrations in holotype (Fig. 5) and ten in paratypes, but are smooth and not serrated in a larger female (Fig. 6). Dermal denticles on the inter-orbital region are not serrated on their posterior margins, and lack pointed processes (Figs. 5, 6). External surface of each denticles with three distinct longitudinal ridges, the median ridge longer and higher than the lateral ridges; no transverse ridges. Dermal denticles of a juvenile (492 mm TL, male) tridentate, with three longitudinal ridges and no transverse ridges; lateral ridges higher than median ridge (Fig. 6); external surface of each denticle slightly concave.

Outer margins of all fins lacking denticles. Outer margins of nostrils, borders of mouth and gill opening, axilla of pectoral fin, posterior region of bases of 1st and 2nd dorsal fins and inner margin of clasper covered with mucus, but denticles are present underneath the mucus.

Color uniformly black.

Number of turns in the spiral valves are 12~15 in seven paratypes.

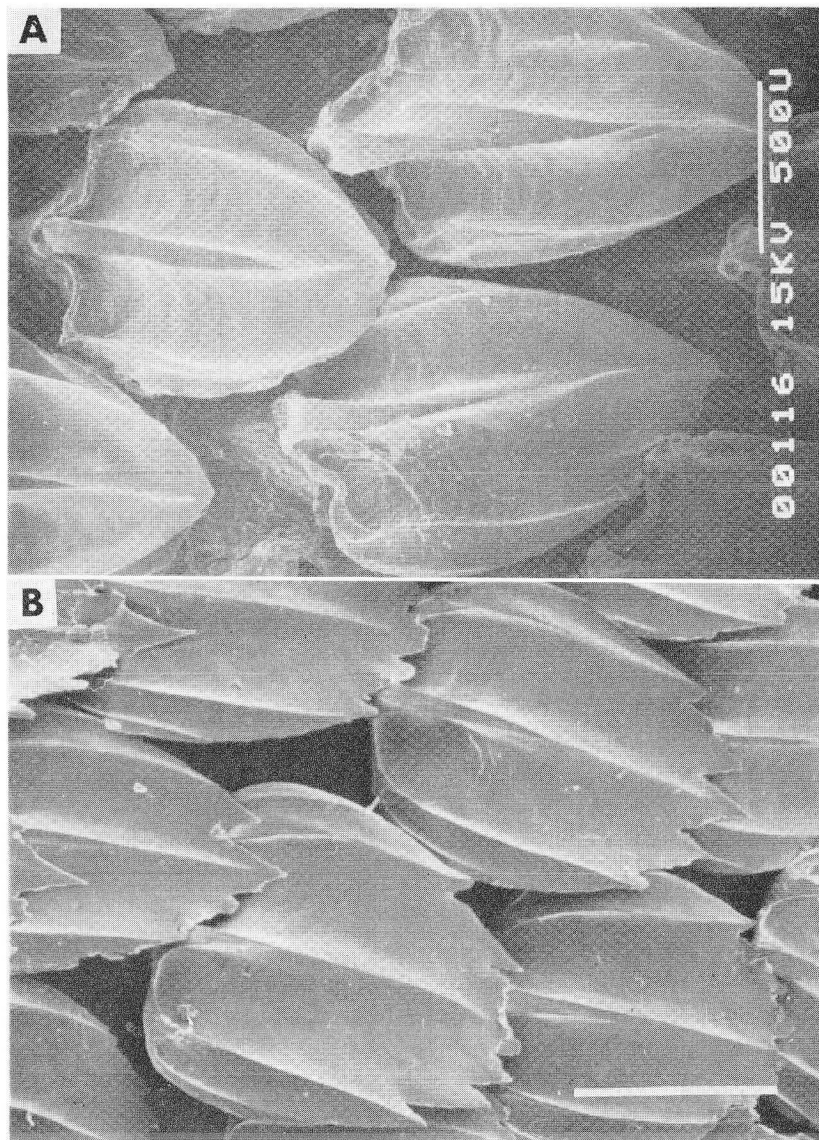


Fig. 5. Dermal denticles of holotype of *Scymnodon ichiharai* sp. nov., adult male, 1,011 mm TL, NSMT-P 21723. A, interorbital region; B, side of trunk below 1st dorsal fin. Each scale indicates 500  $\mu$ m.

Total vertebral number 102, monospondylous 57, and precaudal 76 in a juvenile specimen (TMFE 1275).

**Distribution.** The adults and immatures of *S. ichiharai* were caught in Suruga Bay, with bottom longline and bottom drop line, which were set at depths between 500 m and 800 m. The juvenile, however, was caught at the entrance of Suruga Bay, with bottom longline which was set at depths between 450 m and 830 m. This

species is rare in Suruga Bay. Thirteen specimens of *S. ichiharai* were caught on 14,800 hooks (19 operations) with bottom longline, which were set at depths between 400 m and 830 m, and three specimens were caught on the 2,240 hooks (112 operations) with bottom drop line, which were set between 400 m and 1,500 m.

**Reproduction.** The males, from 892 mm to 1,011 mm TL, were considered to be mature, since they had large and hard claspers with spurs.

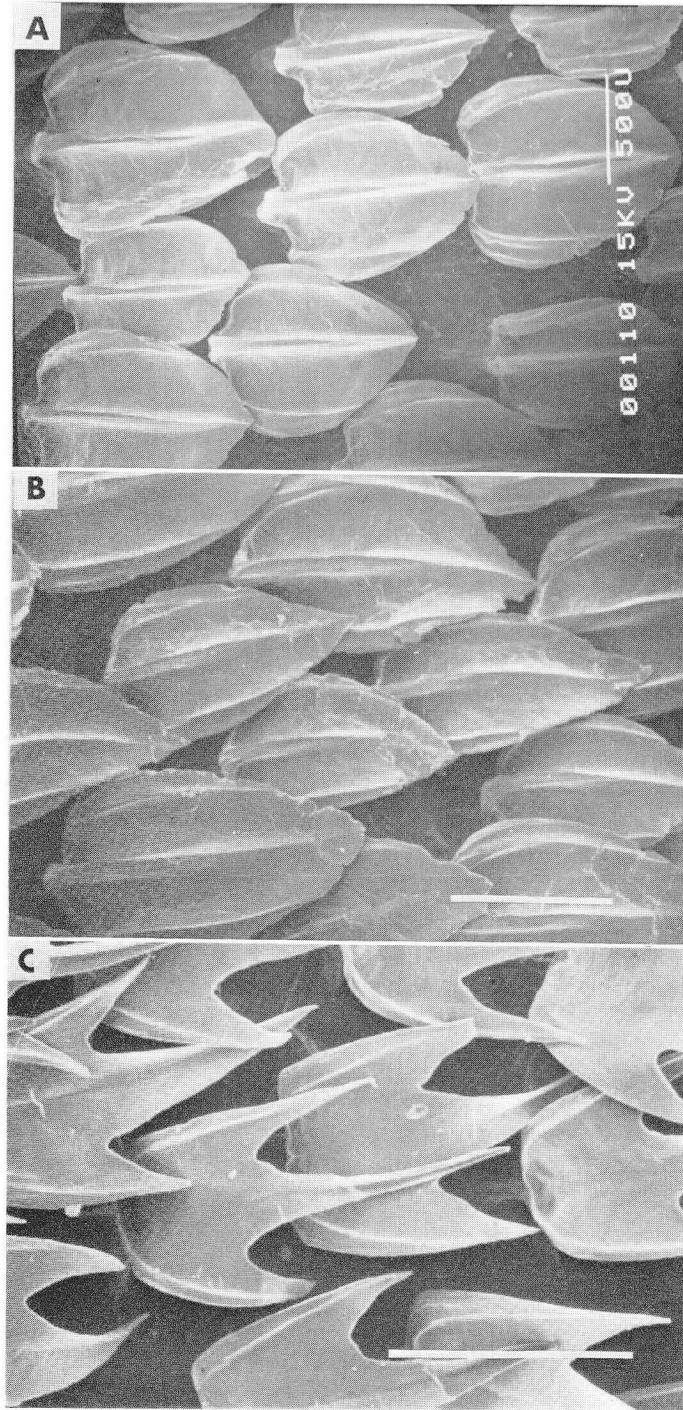


Fig. 6. Dermal denticles of paratypes of *Scymnodon ichiharai* sp. nov. A, interorbital region, adult female, 1,455 mm TL, FUMT-P 3850; B, side of trunk below 1st dorsal fin, specimen same as A above; C, side of trunk below 1st dorsal fin, juvenile male, 492 mm TL, TMFE 1275. Each scale indicates 500  $\mu$ m

Table 2. Proportional dimensions in percentage of total length of *S. ringens* and *S. plunketi*.

Catalogue number	<i>S. ringens</i> MNHN 1969-90	NSMT-P 42001	<i>S. plunketi</i> FSFL-L 461	FSFL-EH 858
Sex	female	male	male	female
Total length (mm)	295	1,155	1,185	968
Snout tip to:				
outer nostrils	—	0.9	1.1	0.9
eye	4.8	3.0	3.5	3.3
spiracle	—	9.1	9.7	9.8
mouth	8.6	5.4	5.5	6.6
1st gill opening	—	13.4	14.4	15.0
5th gill opening	—	17.3	17.8	18.8
pectoral origin	25.0	17.5	18.1	19.0
pelvic origin	62.0	59.3	60.3	58.1
cloaca	64.7	64.1	65.4	62.5
1st dorsal spine origin	42.8	35.1	36.5	35.1
2nd dorsal spine origin	66.8	67.1	67.2	65.0
upper caudal origin	79.8	81.0	79.6	78.2
lower caudal origin	—	77.0	78.5	77.3
Interspace between:				
1st dorsal and 2nd dorsal spine origins	—	28.1	27.3	25.3
2nd dorsal and caudal	—	9.1	7.6	8.5
pelvic and caudal	—	13.0	12.2	13.7
Distance between origins of pectoral and pelvic	—	44.2	41.1	40.6
Nostrils: distance between inner corners	4.1	3.5	3.5	3.6
Mouth width	—	8.4	8.4	8.8
Preoral clefts: distance between inner corners	7.5	5.2	4.7	4.4
Gill opening lengths:				
1st	—	1.3	1.7	2.1
5th	—	2.2	1.7	1.9
Horizontal diameter of eye	9.6	4.1	4.2	4.9
Interorbital width	—	8.0	7.0	8.1
First dorsal fin:				
length of base from spine	—	4.5	4.2	4.9
length of posterior margin	—	4.8	4.9	7.2
height	—	3.6	3.7	3.7
Second dorsal fin:				
length of base from spine	—	5.2	5.1	5.3
length of posterior margin	—	6.9	6.1	6.2
height	—	4.4	4.5	5.1
Pectoral fin:				
length of anterior margin	—	13.2	12.7	13.7
length of distal margin	—	5.4	4.4	6.2
Pelvic fin:				
length of anterior margin	—	6.1	6.0	6.9
depth	—	4.3	4.6	5.2
Caudal fin:				
length of upper lobe	26.0	20.6	21.0	21.7
length of lower lobe	—	12.3	10.1	12.0
depth of notch	—	2.6	2.3	2.7
Trunk at pectoral origin:				
width	—	13.9	14.7	15.2
height	—	11.7	13.5	11.4

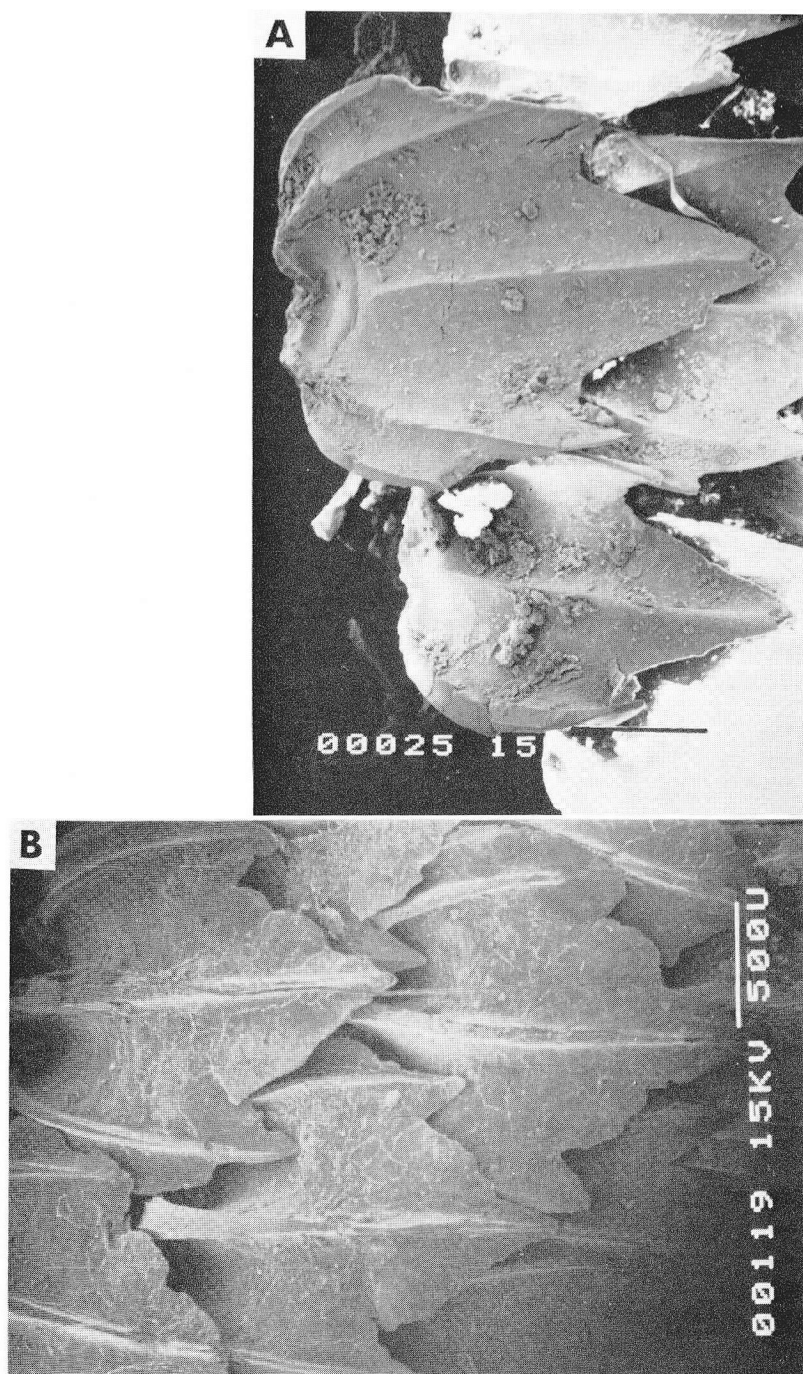


Fig. 7. Dermal denticles on the trunk below 1st dorsal fin of *Scymnodon ringens* and *S. plunketi*. A, syntype of *S. ringens*, 880 mm TL, BMNH 1867. 7. 23.3; B, *S. plunketi*, Canterbury Museum Fish cat No. 437, 1,375 mm TL. Each scale indicates 500  $\mu$ m.



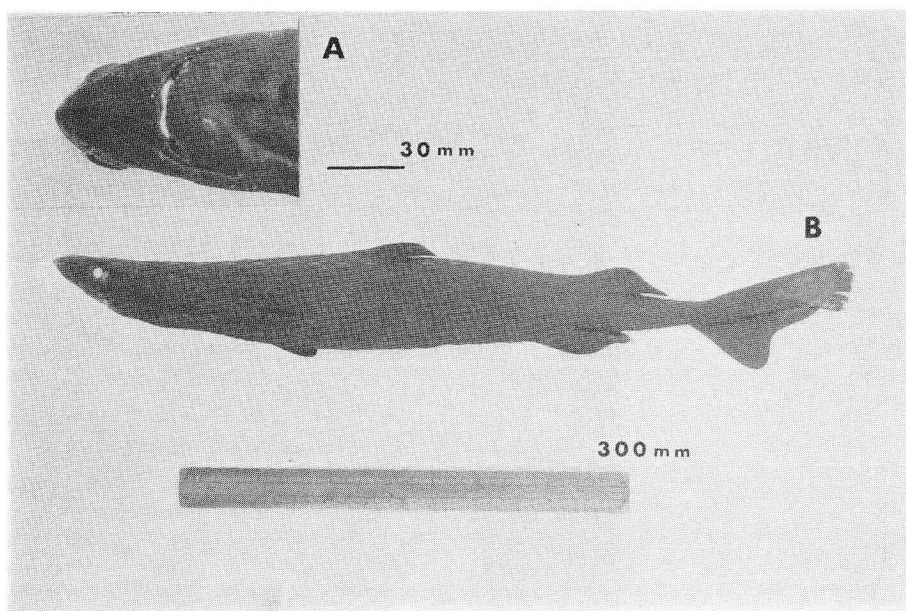


Fig. 8. *Scymnodon squamulosus*, male, 547 mm TL, NSMT-P 21725. A, ventral view of head region; B, lateral view.

Testis weight was 36.6 g in 993 mm TL and 42.7 g in 892 mm TL. The juvenile, 492 mm TL, had very small and soft claspers.

Five larger females, from 1,260 mm to 1,455 mm TL, had developing ova. The ovary contained 29 to 56 ova measuring 30 mm to 50 mm in diameter, and the uteri measured 20 mm to 45 mm in width. One immature female, 1,055 mm TL, had small ova measuring less than 5 mm in diameter and undeveloped uteri measuring 8 mm in width.

**Etymology.** The specific name *ichiharai* is dedicated to the late Dr. Tadayoshi Ichihara who was a Professor of Tokai University and suggested this work.

**Remarks.** The proportional dimensions in percentage of TL of the closely related *S. ringens* and *S. plunketi* are shown in Table 2. *S. ringens* differs from *S. ichiharai* in having: longer head region, e.g., distance from snout tip to mouth, distance from snout tip to pectoral origin; longer distance from snout tip to 1st dorsal spine origin; longer upper caudal lobe and eye diameter (Tables 1, 2); and tridentate dermal denticles in the adults (Fig. 7A). *S. plunketi* differs from *S. ichiharai* in having: shorter head region, e.g., distance from snout tip to outer nostrils, to eye, to spiracle, to mouth

and to pectoral origin; longer upper caudal lobe; (Tables 1, 2); and tridentate dermal denticles in the adults (Fig. 7B).

*Scymnodon squamulosus* (Günther, 1877)  
(Japanese name: Biroudozame)  
(Fig. 8)

*Centrophorus squamulosus* Günther, 1877: 433, (type locality: Japan). Günther, 1887: 5~6, pl. II, fig. B.

*Centroscymnus obscurus* Vaillant, 1888: 67~68, pl. II, fig. 2a~e (type locality: Soudan).

*Zameus squamulosus*: Jordan and Fowler, 1903: 633 (Japan).

*Scymnodon squamulosus*: Regan, 1908: 48; Garman, 1913: 209; Fowler, 1930: 496; Schmidt, 1931: 7 (Japan).

*Scymnodon obscurus*: Bigelow and Schroeder, 1957: 101; Krefft, 1980: 3~7, fig. 1 (Atlantic); Nakaya, 1982: 47, pl. 9 (Japan).

**Material examined.** NSMT-P 21725, male, 547 mm TL, 437 mm BL, entrance of Suruga Bay (off Omaezaki, F8), 450~830 m in depth, bottom longline, Nov. 9, 1982. TMFE 1274, male, 522 mm TL, 416 mm BL, entrance of Suruga Bay (off Omaezaki, F8), 450~830 m in depth, bottom longline, Nov. 9, 1982. TMFE 522, male, 527 mm TL, 421 mm BL, outside Suruga Bay (Kanesu-no-se, F9), bottom longline, July 26, 1981. FUMT-P 3858,



male, 539 mm TL, 430 mm BL, outside Suruga Bay (Kanesu-no-se, F9), bottom longline, July 26, 1981. FSFL-EB 527, female, 634 mm TL, 527 mm BL, off Australia (33°58.2'S, 114°21.3'E), 965 m in depth, bottom trawl net (Kaiyo Maru), Nov. 23, 1975. NSMT-P 40455, male, 284 mm TL, 222 mm BL, off Suriname (7°46'N, 54°14'W), Jan. 17, 1980. NSMT-P 40454, male, 262 mm TL, 202 mm BL, off Suriname (6°51'N, 52°26'W), 675 m in depth, Jan. 26, 1981. NSMT-P 40458, male, 392 mm TL, 310 mm BL, off Suriname. NSMT-P 40457, male, 365 mm TL, 290 mm BL, off Suriname (7°44'N, 53°50'W) 726 m in depth, Nov. 27, 1980. NSMT-P 40453, female, 334 mm TL, 261 mm BL, off Suriname (7°43'N, 53°59'W), 570 m in depth, June 16, 1981. NSMT-P 40452, female, 352 mm TL, 278 mm BL, off Suriname (7°53'N, 54°08'W), 620 m in depth, Apr. 6, 1980. NSMT-P 40456, female, 332 mm TL, 262 mm BL, off Suriname (6°52'N, 52°29'W), 625 m in depth, Jan. 26, 1981.

**Diagnosis.** Length from snout tip to 1st dorsal fin spine 49.4~56.4% of body length. Interspace between pelvic and caudal fins 13.4~17.6% of body length. Preoral length about equal to mouth width. First dorsal fin triangular.

Size of 2nd dorsal fin about equal to pelvic fin. Cutting edges of lower teeth inclined toward the outer corner of jaw. Median lower tooth symmetrical. Dermal denticles leaf-like, tridentate. External surface of each denticle has three distinct longitudinal ridges and transverse ridges.

**Description.** Proportional dimensions in percentage of TL are shown in Table 3.

Trunk subcylindrical, moderately elongate; head depressed, flat above; abdomen with distinct abdominal ridges ventrolaterally. Caudal peduncle without lateral keels or precaudal pits. Snout length anterior to eye 0.69~1.14 (1.00~1.13 in ranges of seven Atlantic specimens, NSMT-P 40452~NSMT-P 40458) in horizontal diameter of eye and 1.41~2.00 (1.70~2.21) in interorbital length. Length from posterior end of eye to 1st gill opening slightly longer than snout tip to mouth. Length from snout tip to mouth 1.00~1.15 (0.96~1.16) in posterior end of eye to 1st gill opening. Eye large, vertical diameter of eye 2.17~2.50 (2.22~3.40) in horizontal diameter. Spiracle semicircular, its length 3.13~4.33 (2.86~4.40) in horizontal diameter of eye. Gill openings very small,

almost vertical. Length of 1st gill opening 3.67~5.00 (2.86~5.60), 3rd 3.37~5.20 (2.86~5.60) and 5th 2.75~4.33 (2.86~4.40) in horizontal diameter of eye. Nostrils oblique, each nasal aperture subdivided into a circular, antero-lateral aperture and an elongate, subovoidal, posteromedial aperture by posterior nasal flap, which extends anteriorly as a fleshly triangular process from posterior nasal margin. Mouth little arched. Mouth width as long as the preoral length. Preoral length 0.84~1.05 (0.86~1.11) in mouth width. Upper lip fimbriated, lower lip smooth. Preoral clefts deep. Distance between inner corners of the nostrils 1.09~1.44 (0.95~1.33) in distance between inner ends of preoral clefts. Pectoral fin, when laid back, clearly forward of 1st dorsal spine. First dorsal fin triangular (Fig. 3B). First dorsal fin similar in shape to 2nd dorsal fin. Length of 1st dorsal fin base, from point of emergence of spine to rear end, shorter than that of 2nd dorsal base similarly measured. Length of 1st dorsal fin base 1.39~1.75 (1.25~1.73) in length of 2nd dorsal base. First dorsal fin lower than 2nd dorsal fin, height of 1st dorsal fin 1.05~1.58 (1.10~1.63) in that of 2nd dorsal fin. First dorsal spine scarcely projecting beyond the skin, length of spine 16.7~31.6% (11.1~14.3%) of height of 1st dorsal fin. First dorsal fin base 5.00~6.17 (5.33~7.00) in head length. Size of 2nd dorsal fin about the same as pelvic fin. Second dorsal fin triangular. Height of 2nd dorsal fin 1.32~1.90 (1.44~1.90) in length of 2nd dorsal base. Second dorsal spine scarcely projecting beyond the skin. Length of 2nd dorsal spine 5.6~30.0% (8.3~15.4%) of height of 2nd dorsal fin. Pectoral fin rounded, posterior margin slightly curved. Pelvic axilla anterior to 2nd dorsal spine. Subterminal notch clear. Clasper subcylindrical, with spur present.

Dental formulae  $\frac{(25\sim28)-(1\sim2)-(21\sim28)}{(16\sim19)-1-(15\sim19)}$  in four specimens. Upper teeth smooth-edged, lanceolate-shaped. Counting from the symphysis, the teeth in the 1st and 2nd series are smaller than those in the 4th to 11th series, which include the largest teeth in the upper jaw (Fig. 8). Lower teeth triangular, their cutting edges inclined toward the outer corners of the jaw, except for median symmetrical tooth (Fig. 9). Two or three rows of teeth regularly functional in upper jaw, and one in lower jaw.

Talbe 3. Proportional dimensions in percentage of total length of *S. squamulosus* and *S. obscurus*. B, broken.

Catalogue number	<i>S. squamulosus</i>						<i>S. obscurus</i>						
	NSMT-P 40454	NSMT-P 40455	NSMT-P 40457	NSMT-P 40458	TMFE 1274	TMFE 522	FUMT-P 3858	NSMT-P 21725	NSMT-P 40456	NSMT-P 40453	NSMT-P 40452	FSFL-EB 527	Holotype MNHN 84-388
Sex	male	male	male	male	male	male	male	male	female	female	female	female	female
Total length (mm)	262	284	365	392	522	527	539	547	332	334	352	634	590
Snout tip to:													
outer nostrils	1.2	2.8	1.9	2.3	1.5	2.5	1.3	1.8	1.8	1.8	2.3	2.1	—
eye	5.7	4.6	4.9	5.6	4.6	6.1	4.1	4.4	4.8	5.1	5.7	6.2	6.4
spiracle	12.6	12.0	11.5	11.2	10.3	12.3	10.0	10.2	11.8	12.3	12.8	12.3	11.4
mouth	10.7	9.2	8.2	9.2	7.3	9.3	7.4	7.3	8.1	8.7	10.5	7.9	7.0
1st gill opening	19.9	18.3	17.3	17.4	16.9	17.3	15.2	15.7	18.4	18.9	19.0	16.7	—
5th gill opening	23.7	22.2	21.9	21.9	21.6	22.4	20.6	20.1	22.6	23.1	23.3	21.9	—
pectoral origin	24.1	23.6	22.5	22.5	21.8	22.6	21.2	20.8	23.5	23.7	23.6	23.7	23.1
pelvic origin	55.7	57.8	56.4	58.4	58.4	59.9	57.5	60.3	59.0	56.3	58.2	61.0	59.3
cloaca	59.9	62.3	63.8	61.5	64.4	63.8	62.5	64.5	63.9	61.4	62.5	65.9	63.7
1st dorsal spine origin	43.5	42.6	41.6	42.9	40.2	40.6	40.5	39.5	43.4	42.8	42.6	41.2	40.7
2nd dorsal spine origin	66.0	64.8	67.1	68.6	67.0	67.2	66.2	66.5	66.0	65.6	68.5	69.7	66.1
upper caudal origin	77.1	78.2	79.5	79.1	79.7	79.9	79.8	79.9	78.9	78.1	79.0	83.1	80.5
lower caudal origin	76.0	75.4	75.9	77.0	78.0	77.6	77.9	79.0	76.5	75.5	76.1	80.4	—
Interspace between:													
1st dorsal and 2nd dorsal spine origins	21.0	20.1	22.2	21.7	23.9	—	21.3	23.8	18.1	18.3	21.9	24.9	—
2nd dorsal and caudal pelvic and caudal	6.5	8.8	8.8	6.4	8.4	8.7	9.1	8.6	7.8	6.6	8.5	7.9	—
pelvic and caudal	12.6	14.1	11.2	12.0	14.0	13.5	14.3	12.8	10.5	10.5	11.4	11.8	—
Distance between origins of pectoral and pelvic	31.7	35.2	34.8	36.0	36.8	37.0	35.8	39.5	34.9	33.2	33.0	36.4	—
Nostrils: distance between inner corners	4.6	3.5	4.7	4.3	4.4	3.8	3.3	4.2	4.2	4.8	4.8	4.4	3.7
Mouth width	9.9	8.8	9.0	8.9	7.3	7.8	7.8	7.3	9.0	9.6	9.1	7.7	7.6
Preoral clefts: distance between inner corners	6.1	5.3	5.8	4.9	4.8	—	4.8	4.9	5.4	4.8	5.1	4.7	4.1

Gill opening lengths:															
1st	1.5	1.1	1.6	1.0	1.1	1.1	1.1	0.9	1.3	2.1	1.8	1.7	1.9	—	—
5th	1.5	1.8	1.6	1.3	1.1	1.5	1.5	1.5	1.3	2.1	2.1	1.7	1.9	—	—
Horizontal diameter of eye	6.1	6.0	6.3	5.6	5.0	4.2	4.6	4.6	4.8	6.0	6.0	5.7	5.5	4.8	—
Interorbital width:	11.1	9.9	10.1	10.2	8.8	8.5	8.2	8.2	8.2	9.9	9.0	9.7	9.8	—	—
First dorsal fin:															
length of base from spine	3.4	3.5	4.1	4.1	4.2	—	3.3	3.3	4.0	3.3	3.3	4.3	4.4	4.4	—
length of posterior margin	3.8	3.9	4.1	3.3	3.8	4.7	2.8	2.8	4.6	3.0	3.0	2.8	4.7	—	—
height	3.1	2.8	2.5	2.0	3.3	2.5	2.2	2.2	3.5	2.1	2.1	2.3	2.7	—	—
spine length	0.4	0.4	0.3	0.3	B	0.6	0.4	0.4	1.1	0.3	0.3	0.3	1.1	—	—
Second dorsal fin:															
length of base from spine	5.7	4.6	5.5	5.1	7.3	—	4.6	5.9	5.9	4.8	5.7	6.0	6.0	7.6	—
length of posterior margin	6.1	5.3	6.9	5.6	6.7	6.6	5.9	7.7	7.7	6.0	6.3	5.7	7.9	—	—
height	3.8	3.2	3.0	3.3	3.8	3.4	3.5	3.7	3.7	3.3	3.0	3.4	3.2	—	—
spine length	0.4	0.4	0.3	0.5	B	0.2	0.4	1.1	1.1	0.3	0.3	0.3	1.0	—	—
Pectoral fin:															
length of anterior margin	9.9	9.5	11.5	12.0	11.5	11.8	12.2	11.9	11.9	12.1	10.8	12.2	11.0	12.5	—
length of distal margin	5.3	5.3	5.8	5.1	5.6	6.3	5.6	4.6	4.6	4.5	5.7	4.3	5.5	4.9	—
Pelvic fin:															
length of anterior margin	5.0	4.9	8.2	5.4	6.9	6.6	7.4	8.2	8.2	7.5	4.5	6.3	6.6	7.1	—
depth	3.8	3.9	4.1	2.8	4.0	—	3.9	3.8	3.8	3.3	3.0	3.4	3.3	—	—
Caudal fin:															
length of upper lobe	22.9	20.8	20.6	21.7	20.1	20.9	20.4	19.4	19.4	23.2	22.5	21.9	19.7	17.3	—
length of lower lobe	11.5	10.6	12.3	11.7	11.9	11.4	12.4	10.2	10.2	11.1	13.5	12.8	12.6	12.4	—
depth of notch	2.7	3.9	4.1	3.8	2.9	2.7	2.8	3.7	3.7	3.6	3.6	4.3	3.3	—	—
Trunk at pectoral origin:															
width	15.3	13.0	14.0	13.5	12.6	11.0	12.2	12.2	12.2	14.5	12.6	14.2	12.6	—	—
height	13.4	11.6	12.6	10.2	10.9	11.0	9.3	8.8	8.8	12.7	12.0	12.2	11.8	—	—

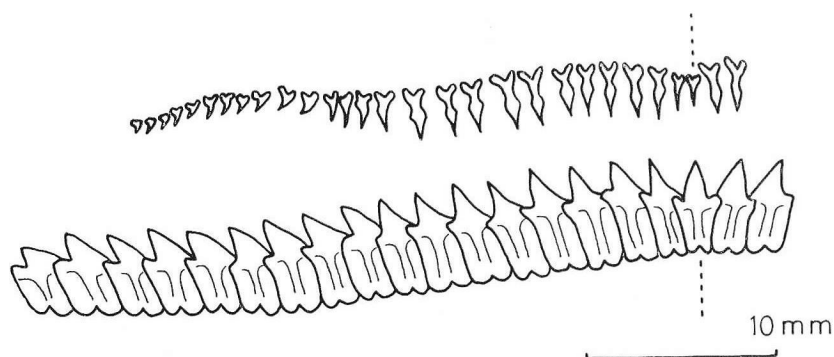


Fig. 9. Teeth of *Scymnodon squamulosus*, male, 527 mm TL, TMFE 522.

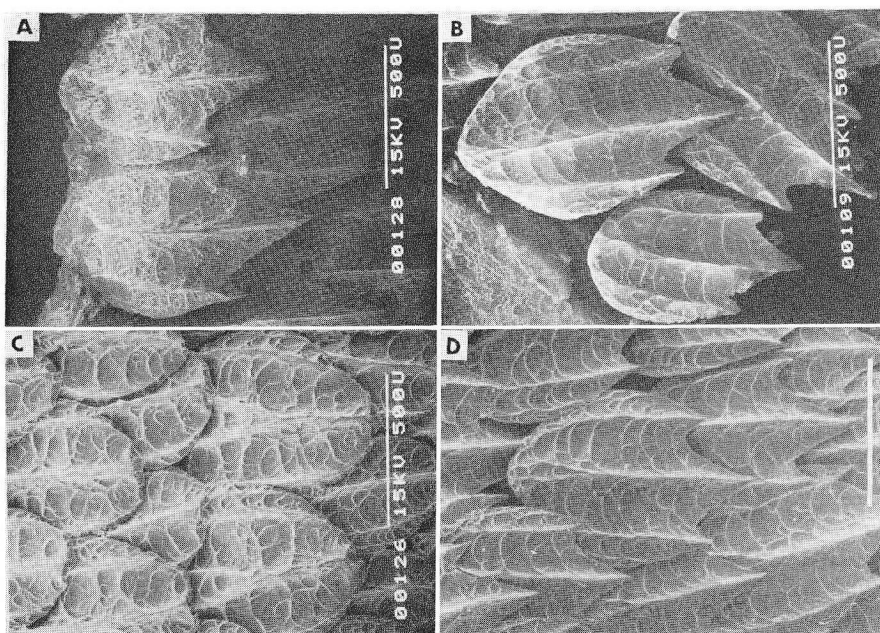


Fig. 10. Dermal denticles of *Scymnodon squamulosus* and *S. obscurus*. A, holotype of *S. squamulosus*, 670 mm TL, BMNH 1880. 5.1.1, side of trunk below 1st dorsal fin; B, holotype of *S. obscurus*, female, 590 mm TL, MNHN 84-388 (Muséum National d'Histoire Naturelle), side trunk below 1st dorsal fin; C, *S. squamulosus*, adult male, 547 mm TL, NSMT-P 21725, interorbital region; D, specimen same as C above, side of trunk below 1st dorsal fin. Each scale indicates 500  $\mu$ m.

Dermal denticles very small, leaf-like, with three longitudinal ridges, including a median ridges extending to posterior edge of the denticle, and with transverse ridges. Posterior margin of the dermal denticles on the trunk below 1st dorsal fin have three pointed processes, the median process longest (Fig. 10). Dermal denticles on the interorbital region and preoral region have rounded posterior margins. Posterior

margin of the upper caudal lobe lacks denticles. Denticles of juveniles (262 ~ 392 mm TL, males) similar to those of adults (522 ~ 547 mm TL, males).

Color uniformly black.

Number of turns in spiral valves 16 (TMFE 522).

Total vertebral number 93, 98, 103 and 105 (97 ~ 102), monospondylous 54, 50, 51 and 53

(51~53), and precaudal 67, 69, 73 and 76 (72~75).

**Distribution.** Four adult males of *S. squamulosus* were caught outside Suruga Bay, i.e., at Kanesu-no-se and off Omaezaki, in depths from 450 m to 830 m, on two bottom longlines which had 1,700 hooks in total. Inside Suruga Bay, however, no *S. squamulosus* have been caught in spite of greater fishing effort, i.e., 17 bottom longline operations (13,100 hooks) and 112 bottom drop line operations (2,240 hooks). At depths between 39 m and 56 m in the northwestern North Pacific (Fig. 1, F10) where water temperature was about 10°C, seven mature females and one immature female of this shark were caught with floating longlines for salmon sharks (*Lamna ditropis*).

These results suggest that this species is distributed outside the bay, is oceanic and not always a deep sea inhabitant, and comes near the surface when the temperature is low enough. Seasonal segregation by sex and size seems to occur.

**Reproduction.** Males, from 522 mm TL to 547 mm TL, were considered to be mature since they had large, hard claspers with spurs. Testis weight was 8.70 g in a 527 mm TL specimen. Juvenile males, from 262 mm to 392 mm TL, had very small and soft claspers.

Six mature females, from 750 mm to 840 mm TL, had developing ova. The ovaries contained 3 to 10 ova measuring 10 mm to 40 mm in diameter, and the uteri measured 10 mm to 15 mm in width. A mature female, 770 mm TL, had undeveloped ova measuring less than 5 mm in diameter and developed uteri of 20 mm in width. One immature female, 720 mm TL, had small ova measuring less than 8 mm in diameter and undeveloped uteri measuring 4 mm in width. Ovary weight in mature females was from 15 g to 110 g.

**Remarks.** In separating *S. squamulosus* from *S. obscurus*, the presence or absence of transverse ridges on the dermal denticles was previously used as the main taxonomic character (Bigelow and Schroeder, 1957; Cadenat and Blache, 1981). But examination of the dermal denticles of the type specimens and of our specimens revealed that the transverse ridges are present in the denticles of *S. squamulosus*, just as they are in *S. obscurus* (Fig. 10A, B).

Proportional dimensions of the type specimen and of Atlantic specimens of *S. obscurus* in percentage of total length are shown in Table 3; the dimensions do not seem to be different in *S. squamulosus* and *S. obscurus*. Therefore, we consider *S. obscurus* as a junior synonym of *S. squamulosus*. In immature Atlantic specimens, the 1st dorsal fin spine is located posterior to the mid point of body length, but in mature Japanese specimens, and in the holotype of *S. obscurus*, the 1st dorsal fin spine is located about the middle of body length. It is concluded that the location of spine changes with growth of the shark. Yano and Tanaka (1983) reported that the body proportions of the genus *Centroscyrnus* changed with growth of the shark, just as this case.

#### Key to species of *Scymnodon*

- 1a. Outer surface of dermal denticles with transverse ridges.....*S. squamulosus*
- 1b. Outer surface of dermal denticles without transverse ridges.
- 2a. First dorsal spine located posterior to mid point of body length; subterminal notch scarcely evident; median lower tooth symmetrical; posterior margin of dermal denticles on side of trunk tridentate.....*S. ringens*
- 2b. First dorsal spine located anterior to mid point of body length; subterminal notch well-developed; median lower tooth not symmetrical.
- 3a. Posterior margin of dermal denticles on side of trunk tridentate; interspace between pelvic and caudal fins 15.4~17.6% of body length.....*S. plunketi*
- 3b. Posterior margin of dermal denticles on side of trunk not tridentate but serrated or smooth in adults though tridentate in juvenile; interspace between pelvic and caudal fins 10.2~14.0% of body length...*S. ichiharai* sp. nov.

#### Discussion

In *S. ichiharai* the median lower tooth is not symmetrical (Fig. 4) and the 1st dorsal fin has a steeply sloped posterior margin (Fig. 3); these characters are similar to those of the genus *Centroscyrnus*. We consider, however, that *S. ichiharai* is included in the genus *Scymnodon*

because of the following characters: the upper teeth are much longer midway along each side of jaw than toward either the center of mouth or its outer corner; the lower teeth are more erecter than those of *Centroscymnus*; and the dermal denticles lack concave crowns. Garrick (1959b) stated that the lower teeth are not always reliable criteria even in *Centroscymnus*, and where there is confusion with reference to the upper and lower teeth this can be resolved in all except the most juvenile specimens by examination of the dermal denticles. The dermal denticles are not in the form of concave crowns in *C. rossi* Alcock, 1898, *C. macracanthus*, *C. waitei* Thompson, 1930, and *C. furvescens* Buen, 1960. *C. rossi* and *C. waitei* were described from juvenile specimens (Alcock 1898; Thompson, 1930) and their denticles are strongly tridentate, just as juvenile denticles of *C. owstoni* and *C. coelolepis* (Yano and Tanaka, 1983). Garrick (1959b) reported that *C. waitei* was, in fact, a juvenile of *S. plunketi*. The dermal denticles on the side of trunk of *C. crepidater* Bocage and Capello, 1864 (FSFL-EA 634, female, 848 mm TL, 47°21.5'S, 148°01.7'E) and *C. furvescens* are similar to those of the head region of *C. owstoni* (Buen 1960; Yano and Tanaka 1983). We believe that the denticles of *C. macracanthus* are probably similar to those of *C. crepidater* and *C. furvescens*, judging from a description in Garman (1913). In the above four species whose descriptions are not always sufficient for comparison, at least *C. furvescens* can be distinguished from *S. ichiharai* in having the arrangement of teeth; *C. rossi* and *C. crepidater* in having the very long preoral clefts; and *C. macracanthus* in having the pectoral fin reaching a vertical from the 1st dorsal fin spine. We think that the above four species probably refer to *Centroscymnus* or *Centrophorus* because of the arrangement of the teeth. *S. plunketi* and *C. macracanthus* have been variously placed in *Centroscymnus*, *Centrophorus* and *Scymnodon* by several authors (Regan 1906; Waite 1910; Garman 1913; Bigelow and Schroeder 1957; Garrick 1959b; Cadenat and Blache 1981). The dermal denticles of *S. ichiharai* are tridentate in juveniles, and in this character and in their lower teeth they are similar to the description of *S. plunketi* by Waite (1910) and Garrick (1959b). The denticles of *S. ringens* are tridentate in a

juvenile female (295 mm TL, MNHN 1969-90). Tridentate dermal denticles were found in juveniles of *Centroscymnus owstoni* and *C. coelolepis* (Bigelow and Schroeder 1954, Garrick 1959a, Yano and Tanaka 1983) and in *C. crepidater* (FSFL-EA 535, male, 340 mm TL, 47°15.1'S, 148°30.8'E) also reported by Garrick (1959a). The shape of the dermal denticles in adults is a key character to differentiate the two genera, but in juveniles there is no difference between *Centroscymnus* and *Scymnodon*. We think that *Scymnodon* is closely related to *Centroscymnus*.

*S. ichiharai* was mostly caught inside Suruga Bay, but *S. squamulosus* was always outside the bay. The two species seem to live separately; *S. ichiharai* is more or less coastal and *S. squamulosus* is oceanic. *S. obscurus* (= *S. squamulosus*) was caught from off Brazil and from the South Atlantic Subtropical Convergence with pelagic trawls (Krefft, 1980). Since this species is reported from the Pacific Ocean, Atlantic Ocean and Indian Ocean (Günther 1877; Vaillant 1888; Bass et al. 1976; Compagno 1977; Krefft 1980; Zhu et al. 1982), *S. squamulosus* seems to be cosmopolitan. Large specimens of *S. ichiharai* were caught in Suruga Bay, but the only small specimen was taken off Omaezaki at the entrance to the bay. Large and small individuals of *S. ichiharai* may live separately, as in the case of *C. owstoni* (Yano and Tanaka, in press).

*S. ichiharai* has 29 to 56 developing ova, whereas *S. squamulosus* has only 3 to 10 developing ova, hence the fecundity of *S. ichiharai* is higher than that of *S. squamulosus*.

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senior author, to Dr. Garrick. Dr. Garrick sent back SEM photographs of denticles of the specimen to Dr. Taniuchi with the suggestion of the presence of an undescribed species in Japan. Dr. Garrick's suggestion at the initial stage of this study encouraged the present authors who had also recognized the presence of 2 species of the genus in Japan. We wish to express our sincere thanks to Dr. Ch. Roux, Muséum National d'Histoire Naturelle, Mr. Jean-Pierre Sylvestre, Section: Cétacés et Siréniens, Dr. Peter J. Whitehead, British Museum (Natural History), and Dr. G. A. Tunncliffe, Canterbury Museum for sending dermal denticles and photographs, and for measuring type specimens. We are grateful to Dr. Teruya Uyeno, National Science Museum, Tokyo, for his valuable advice and criticism of the manuscript and for materials, to Dr. Hiroshi Hatanaka, Far Seas Fisheries Research Laboratory, Dr. Kenji Mochizuki, University Museum, University of Tokyo and Mr. Masahiro Aizawa for materials, and to Prof. Tamotu Tamura, Faculty of Marine Science and Technology, Tokai University for his valuable advice and criticism of the manuscript. Also, we are much indebted to Mr. Yasuji Fukuda, Department of Anatomy, University of Tokyo School of Medicine for taking photographs of the denticles. We are grateful to the members of "Hokuto II" and "Bousei-maru II", research vessels of Tokai University, and to the fishermen of "Keiju-maru", "Shinsei-maru", "Choukane-maru" and "Kyuhō-maru" for obtaining specimens.

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# 日本産深海性ツノザメ科ピロードザメ属魚類の再検討および1新種の記載

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駿河湾の水深 450 m から 830 m で得られた新種イチハラピロードザメ *Scymnodon ichiharai* を記載した。さらに、これまで世界中で知られている同属の 4 種についても形態的比較を行った。

従来日本から報告されていたピロードザメ *S. squamulosus* の模式標本を再調査した結果、鱗に transverse ridges が存在し、またその種の外部形態、脊椎骨数、大西洋から報告されている *S. obscurus* と変わらないことが判明した。従って、*S. obscurus* はピロードザメの同種異名と考えられた。ピロードザメ属は、新種を含め 4 種が存在する。これら 4 種の検索表を以下に掲げる。

## ピロードザメ属の検索表

- 1a 鱗に transverse ridges がある……ピロードザメ
- 1b 鱗に transverse ridges がない。
- 2a 第 1 背鰭棘が体長のほぼ中央に位置する; subterminal notch がはっきりしていない; 下顎中央歯が左右相称形である; 鱗の形態は 3 叉形である。……………*S. ringens*
- 2b 第 1 背鰭棘が体長の中央より前方に位置する; subterminal notch がはっきりしている; 下顎中央歯は左右不相称である。
- 3a 鱗の形態は 3 叉形である; 腹鰭と尾鰭の間の距離は体長の 15.4~17.6% である……………*S. plunketi*
- 3b 成魚の鱗の外縁は鋸歯状かあるいはなめらかであり、3 叉形ではない、しかし幼魚においては 3 叉形である。腹鰭と尾鰭の間の距離は体長の 10.2~14.0% である。  
……………*S. ichiharai* sp. nov. イチハラピロードザメ

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